DOCUMENT RESUME

ED 242 773 TM 840 190

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TITLE Counseling Medical Students Preparing for Their Licensure Examination: An Illustration of the Use of Regression Analysis.
PUB DATE 84
NOTE 11p.; Paper presented to the Southern Regional Joint Meeting of the Association of American Medical Colleges (Clearwater Bay, FL, April 11-14, 1984). Small print in Appendix C.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Certification; Counseling Techniques; Graduate Medical Education; *Graduate Medical Students; Higher Education; Multiple Regression Analysis; *Occupational Tests; *Predictive Measurement; Scores
IDENTIFIERS Arkansas; *Federation Licensing Examination; National Board of Medical Examiners; Subject Exam

ABSTRACT

A counseling program for senior medical school students is described. Each student who wishes to participate is provided with a prediction of his or her Federal Licensing Examination (FLEX) score, as well as the probability of passing the FLEX in Arkansas. Predictions were computed by performing regression analyses to obtain equations relating graduating seniors' scores on the FLEX with their previous performances on the National Board of Medical Examiners (NBME) subject examinations and their three year cumulative average in medical school. The predictions could be helpful in a student's preparation for the FLEX. The general approach used in the study may be applied to any situation in which sufficient and appropriate information is available to provide the basis for predicting the future performance of group members. The approach provides a means for making some counseling decisions and recommendations on a more systematic and accurate basis. Technical requirements for computing this information require a professional with masters degree level training in reseach methods and access to a medium size computer. (DWH)

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Counseling Medical Students Preparing for Their Licensure Examination: An Illustration of the Use of Regression Analysis[1]

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In Arkansas, the State Medical Board permits graduating senior medical students to take the Federation Licensing Examination (FLEX)[2] in December of their final year of medical school. For the last four years, we have provided each senior student in our college with a prediction of her or his: FLEX Day 1, Day 2, Day 3 and Total score, as well as the probability of passing the FLEX in Arkansas (i.e., making a weighted total score of 75 or more). Predictions were obtained as follows. In the spring when FLEX scores became available, regression analyses[3] were performed to obtain equations relating graduating seniors' scores on the FLEX with their previous performances on the National Board of Medical Examiners (NBME) subject examinations[2] and their three year cummulative GPA's in medical school. A separate equation was derived for each day score and the total. During the following fall, the equations developed on the previous spring's graduating seniors were used to predict each of the current year's seniors' performances on the upcoming FLEX to be taken in December. Each senior received his or her predictions along with appropriate explanatory information (Appendix B). Appendix C provides example 'tear-sheets' with predictions for three actual students. The tear-sheets were produced by a locally written computer program which used the prediction equation and information on each student to produce the reports illustrated in Appendix C. Because each day's exam emphasized different aspects of medical education and competence, the specific predictions provided for each day gave the student an idea of his or her areas of relative strength and weakness. Practice versions of the FLEX given in group sessions, as well as, suggestions for review were offered as described in Appendix D) for those students wanting assistance with their preparation.

Table 1 provides descriptive statistics (i.e., means and standard deviations) for both predicted and observed FLEX scores for each senior class 1981-83. There were no important systematic differences in the observed and predicted means. While the variability (SD) of observed scores appeared a little greater than for predicted FLEX scores, it was not significantly so.

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[1]Presented to the Group on Student Affairs, Southern Regional Joint Meeting, Association of American Medical Colleges, Tampa (Clearwater Bay), Florida, April 11-14, 1984. Address communications to: Gerald J. Cason, UAMS-OED-595, 4301 West Markham, Little Rock, AR 72205. Phone: (501) 661-5720.

[2]See Hubbard (1978) for details of NBME examinations.

[3]Appendix A gives brief explanation of regression analysis.

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Table 1. Performance of UAMS College of Medicine Graduates of 1981-83 on the FLEX

	1981 (N=117)		1982 (N=123)		1983 (N=114)	
	Predicted	Observed	Predicted	Observed	Predicted	Observed
Day 1: Mean	76.0	77.0	76.8	76.4	72.0	78.2
SD	3.4	4.1	3.2	4.0	2.4	3.5
Day 2: Mean	80.6	81.2	81.1	81.3	80.6	81.5
SD	3.0	3.4	2.4	3.4	2.6	3.2
Day 3: Mean	81.3	80.7	81.0	82.4	82.3	82.1
SD	2.4	3.2	2.0	3.1	1.9	2.4
Total: Mean	80.9	80.3	80.4	81.1	80.5	81.2
SD	2.6	3.1	2.3	3.1	2.4	2.6

N = number of students for whom complete data were available.
SD = standard deviation.

Table 2 shows the validity coefficients (i.e., correlations between observed and predicted scores) for each year. Validities for the FLEX Total score were quite good. These validities justified the use of the prediction equations for counseling purposes. Note that Day 3 predicted scores had consistently lower validities. Day 3 of the FLEX was most different from the prior experience of the students and therefore about which our basis for prediction was least complete. Day 3 involved patient management problems (PMP's). The student used a special latent image chemical marker to enter responses to questions in the exam. When the marker was used, new information was revealed. To score well, the new information must be used effectively in further responses to the problem.

Table 2. Validity of Predictions for Classes of 1981-83: Correlation between Predicted and Observed FLEX Scores

	1981	1982	1983
FLEX Day 1	0.80	0.75	0.79
FLEX Day 2	0.74	0.81	0.86
FLEX Day 3	0.66	0.62	0.57
FLEX Total	0.80	0.79	0.82

All correlations (r's) are significant at $p<0.01$

Table 3 gives descriptive statistics for the 1984 Seniors' predicted FLEX scores. These scores were generally similar to previous years' classes'. Because of the short time between this meeting and the report of the current year's FLEX scores, statistics on the observed scores and validity indices could not be provided here.

Table 3. Descriptive Statistics for Predicted FLEX Scores for UAMS Seniors of 1984

	Mean	Standard Deviation
FLEX Day 1	75.4	2.7
FLEX Day 2	81.2	2.8
FLEX Day 3	82.0	1.4
FLEX Total	81.1	2.1

Conclusion

At least four points should be made about the usefulness of predictions based on regression analyses in this program: (1) each successive class of seniors has been very interested in obtaining the predictions as early as possible; (2) each year the number of students choosing to participate in the FLEX practice sessions has increased (69, 83, 86, and 97 students in 1980 through '83); (3) the validity indices (for FLEX Total $r \geq 0.79$) demonstrated that the approach was technically sound; and, (4) the program was relatively inexpensive to administer. However, it was not demonstrated that students do better because this information was provided to them. There was no appropriate group that did not get the predictions with which to compare the performance of the group of students that did recieve this information. Ethical considerations precluded giving it to some and not others to answer this question.

The general approach illustrated here may be applied to any situation in which you have sufficient and appropriate information to provide the basis for predicting the future performance of the members of a group. The approach provides a means for making some counseling decisions and recommendations on a more systematic and accurate basis. The technical requirements are easily met by a professional with masters degree level training in research methods of the social and behavioral sciences and access to a modest to medium size computer. Such resources are available to virtually all medical colleges through their offices of research and development in medical education, institutional research; or, departments of computing, biostatistics or behavioral science.

Reference

Hubbard,J.P. (1978) Measuring medical education: The tests and experience of the National Board of Medical Examiners (2nd. Edition). Philadelphia: Lea and Febiger.

Appendix A.: Intuitive Explanation of Regression Analysis

Regression analysis is a statistical procedure for finding the best equation for relating several things (called predictors) to one thing of special interest (called the criterion). Most commonly this approach is applied to problems of prediction of future performance and selection of candidates. Suppose you know a number of things about the current candidates for admission to a particular program and wish to select the best. In this case, you begin by looking at the information available on an earlier group that was admitted to the program. For example, you might perform a regression analysis on the relation between the grade point averages (GPA) earned by last years freshmen and their entering GPA's and admissions test scores. This analysis would give you the best weights to apply to each predictor (i.e., scores or other information) used to predict the chosen criterion ,i.e., freshman GPA.

The things you used to predict the criterion might do anything from a very good to a very poor job. That is, taken together the weighted combination of the predictors could have anything from a high to a low correlation with the criterion. The degree to which your predictors do a good job of predicting your criterion is suggested by the size of the multiple correlation coefficient, symbolized by capital R. The square of R tells you the proportion of the variation in scores on your criterion which is explained, predicted, or accounted for by you predictors. R's range from 0.0 to 1.0. R's for the relation between college freshman GPA and entering GPA and admission test scores commonly are in the range 0.7 to 0.8.

Once an equation is developed on the information from an earlier (or comparable contemporary) group, this equation is used to predict the performance of the current group of interest. You could use the equation developed on last years freshmen to predict how this years applicants for admission will do. For this to work, the information used as predictors in developing the equation on last years group must do a good job (i.e., have a high R) and the same kinds of information must be available on the group you want to make predictions about.

After you have developed a prediction equation and made predictions on a particular group of students, you probably will want to determine how well your predictions actually fit what happened. If you had predicted freshman GPA, a good measure of the accuracy of you predictions is the correlation between your predictions and the GPA's actually earned. This correlation between your predictions and the actual performance on the criterion is called a validity coefficient or validity index because it shows how valid your predictions were.

When regression analysis is used in student counseling, the focus is first upon determining how well each student is expected to do with respect to some important requirement (i.e., criterion). Then, for those who are predicted to have trouble meeting the standards on the criterion, providing supplimentary assistance in preparing for the criterion task or counseling them into anotner track where they have a higher probability of success. If the criterion were a universal requirement , such as passing a licensure examination, special help in preparing for the exam would be in order. If the criterion were success in a particular residency, then counseling the student to enter a specialty in which there was a higher probabilty of success might be most appropriate. In other cases, a combination of both might be best.

Appendix B.: Typical Information Provided with FLEX Predictions

MEMORANDUM

UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES

DATE: October 17, 1983

TO: Senior Students

FROM: Ture W. Schoultz, Ph.D.
Associate Dean/Student Affairs

SUBJECT: Predicted FLEX Scores

Enclosed you will find a tear-sheet listing your National Board scores, gradepoint average (GPA), and predictions of your scores on the Federation Licensing Examination (FLEX). My office and Dr. Cason of the Office of Educational Development initiated this project in 1980 to provide you information so that you may make a rational and objectively informed assessment of what you need to do in preparation for the FLEX.

Last year's seniors (Class of 1983) received predicted FLEX scores based on their previous NBME scores and GPA.

Class of 1983's Performance on FLEX

	Day 1	Day 2	Day 3	Total
Predicted Mean	72.0	80.6	82.3	80.5
Observed Mean	78.2	81.5	82.1	81.2

Correlation between Predicted and Observed Scores:

r = 0.79 r = 0.86 r = 0.57 r = 0.82

On average last year's seniors did slightly better than predicted. The validity of the predicted totals was quite good (r = 0.82).

The information available (GPA and Board scores) to make your predictions was not sufficient to make predictions of absolute accuracy and certainty. There is a 95% probability that your scores will fall within the ranges listed. All things being equal, 95 out of 100 people will obtain a FLEX score contained in the 95% confidence interval.

Your predictions are based upon the assumption that you will take the FLEX with about an equal level of preparation and competence as those last year who had similar NBME scores. You can either improve or degrade your chances of passing by what you do and fail to do between now and the FLEX exam in December. The attached information is intended to neither alarm you nor lull you into a false sense of security.

Appendix B.: Typical Information Provided with FLEX Predictions (Continued)

The approximate probability of your passing is reported numerically. No matter how low your predicted score, there is some possibility of success. In either case you can raise your probability of passing, by preparing more effectively than did last year's seniors.

Although these predictions can not be interpreted as an endorsement for any specific or general method of preparing for the FLEX, you should keep in mind two facts: 1. the predictions are based in part upon how last year's seniors did on the National Boards and the FLEX and 2. over half of them chose to take advantage of the Review Sessions offered by OED.

Descriptive Statistics for Predicted FLEX Scores
of Seniors of 1984
(based on only those 127 for whom
there was complete data available)

	Mean	SD
Day 1	75.4	2.7
Day 2	81.2	2.8
Day 3	82.0	1.4
Total	81.1	2.1

As these predictions are time consuming to produce, you will be asked sometime after taking the FLEX whether you think this information was useful.

If you have questions about the derivations of the predictions, Dr. Gerald Cason will be happy to answer them. His extension is 5720.

Appendix C.i Photo-reduced Tear-sheets Providing FLEX Predictions for Three Students

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*****     OUTPUT FROM PROGRAM FUTUR     *****                                    PAGE  1P

    PROGRAM BY: GERALD J. CASON, PH.D.
                OFFICE OF EDUCATIONAL DEVELOPMENT, UAMSC, 1984

  OUTPUT TITLE:  PREDICTIONS FOR SRS OF 1984 ON FLEX, EQUA FROM 114 SRS OF 1983

### STUDENT #    28          WITH NBME SCORES OF
        BEHAV SCI=   0, /PATH= 438, /MED= 335,  /SURG= 338, /OBGYN= 458, /PEDI= 258, /PSYCHI= 385, /$ 3 YR  GPA=  1.4
        HAS A : PREDICTED FLEX "BASIC"      (DAY 1) SCORE = 71.2)  95% CONFIDENCE INTERVAL = 67.1 TO 75.3 INCLUSIVE.
              : PREDICTED FLEX "CLIN"       (DAY 2) SCORE = 76.8)  95% CONFIDENCE INTERVAL = 73.7 TO 80.0 INCLUSIVE.
              : PREDICTED FLEX "CLIN-COMP"  (DAY 3) SCORE = 80.7)  95% CONFIDENCE INTERVAL = 76.9 TO 84.4 INCLUSIVE.
               (NOTE: PREDICTED FLEX TOTAL = ((DAY1)+(2*DAY2)+(3*DAY3))/6 )

              : PREDICTED FLEX WEIGHTED TOTAL SCORE = 78.1)  95% CONFIDENCE INTERVAL = 75.3 TO 80.9 INCLUSIVE.

    IF YOU PREPARE FOR THE FLEX WITH EFFECTIVENESS EQUAL TO LAST YEARS STUDENTS HAVING SIMILAR BOARD SCORES AND GPA
    YOUR PREDICTED FLEX TOTAL MEANS THAT YOUR PROBABILITY OF PASSING (MAKING A TOTAL OF 75 OR MORE) IS ABOUT  .985 .
    THIS INFORMATION WAS PREPARED FOR YOUR GUIDANCE BY ORS, TORE SCHOULTZ (ASSOCIATE DEAN,COM) & GERALD CASON (OED).

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### STUDENT #    29          WITH NBME SCORES OF
        BEHAV SCI=   0, /PATH= 455, /MED= 395,  /SURG= 375, /OBGYN= 435, /PEDI= 485, /PSYCHI= 478, /$ 3 YR  GPA=  2.4
        HAS A : PREDICTED FLEX "BASIC"      (DAY 1) SCORE = 73.8)  95% CONFIDENCE INTERVAL = 69.7 TO 77.8 INCLUSIVE.
              : PREDICTED FLEX "CLIN"       (DAY 2) SCORE = 79.3)  95% CONFIDENCE INTERVAL = 76.1 TO 82.5 INCLUSIVE.
              : PREDICTED FLEX "CLIN-COMP"  (DAY 3) SCORE = 81.1)  95% CONFIDENCE INTERVAL = 77.3 TO 84.8 INCLUSIVE.
               (NOTE: PREDICTED FLEX TOTAL = ((DAY1)+(2*DAY2)+(3*DAY3))/6 )

              : PREDICTED FLEX WEIGHTED TOTAL SCORE = 79.6)  95% CONFIDENCE INTERVAL = 76.8 TO 82.4 INCLUSIVE.

    IF YOU PREPARE FOR THE FLEX WITH EFFECTIVENESS EQUAL TO LAST YEARS STUDENTS HAVING SIMILAR BOARD SCORES AND GPA
    YOUR PREDICTED FLEX TOTAL MEANS THAT YOUR PROBABILITY OF PASSING (MAKING A TOTAL OF 75 OR MORE) IS ABOUT  .999 .
    THIS INFORMATION WAS PREPARED FOR YOUR GUIDANCE BY ORS, TORE SCHOULTZ (ASSOCIATE DEAN,COM) & GERALD CASON (OED).

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### STUDENT #    30          WITH NBME SCORES OF
        BEHAV SCI=   0, /PATH= 575, /MED= 518,  /SURG= 585, /OBGYN= 530, /PEDI= 618, /PSYCHI= 618, /$ 3 YR  GPA=  3.2
        HAS A : PREDICTED FLEX "BASIC"      (DAY 1) SCORE = 78.9)  95% CONFIDENCE INTERVAL = 74.9 TO 83.0 INCLUSIVE.
              : PREDICTED FLEX "CLIN"       (DAY 2) SCORE = 85.2)  95% CONFIDENCE INTERVAL = 82.0 TO 88.4 INCLUSIVE.
              : PREDICTED FLEX "CLIN-COMP"  (DAY 3) SCORE = 83.8)  95% CONFIDENCE INTERVAL = 80.1 TO 87.6 INCLUSIVE.
               (NOTE: PREDICTED FLEX TOTAL = ((DAY1)+(2*DAY2)+(3*DAY3))/6 )

              : PREDICTED FLEX WEIGHTED TOTAL SCORE = 83.9)  95% CONFIDENCE INTERVAL = 81.1 TO 86.7 INCLUSIVE.

    IF YOU PREPARE FOR THE FLEX WITH EFFECTIVENESS EQUAL TO LAST YEARS STUDENTS HAVING SIMILAR BOARD SCORES AND GPA
    YOUR PREDICTED FLEX TOTAL MEANS THAT YOUR PROBABILITY OF PASSING (MAKING A TOTAL OF 75 OR MORE) IS ABOUT  .999 .
    THIS INFORMATION WAS PREPARED FOR YOUR GUIDANCE BY ORS, TORE SCHOULTZ (ASSOCIATE DEAN,COM) & GERALD CASON (OED).

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Appendix D.: Excerpt from Seniors' Newsletter of August 1981 Describing Practice FLEX Sessions

PRACTICE FLEX

If you wish to prepare for the FLEX, Dr. Hand in the Office of Educational Development will be administering practice examinations at the time listed below. The practice exams are the Pre-Test for Physicians preparing for the FLEX" by McGraw-Hill, edition 3 (1980) and edition 4 (1982). You do NOT have to purchase these tests. Each testing session is limited to 30 students per test edition. Therefore, if you wish to participate, you should contact my office at Ext. 5348, or send a note indicating the sessions you wish to attend and the edition of the test you wish to take. In 1980, 69 people participated in the "practice FLEX"; in 1981, 83 participated; and in 1982, 86 participated.

ALL SESSIONS WILL BE HELD IN THE 8TH FLOOR LABS, ED II BLDG.

Group 1 - September 6, 7, 8

Tuesday	September 6	Practice FLEX Day 1	6:30-9:30 p.m.
Wednesday	September 7	Practice FLEX Day 2	6:30-9:30 p.m.
Thursday	September 8	Practice FLEX Day 3	6:30-10:30 p.m.

Group 2 - October 11, 12, 13

Tuesday	October 11	Practice FLEX Day 1	6:30-9:30 p.m.
Wednesday	October 12	Practice FLEX Day 2	6:30-9:30 p.m.
Thursday	October 13	Practice FLEX Day 3	6:30-10:30 p.m.

Group 3 - November 8, 9, 10

Tuesday	November 8	Practice FLEX Day 1	6:30-9:30 p.m.
Wednesday	November 9	Practice FLEX Day 2	6:30-9:30 p.m.
Thursday	November 10	Practice FLEX Day 3	6:30-10:30 p.m.

Group 4 - November 29, 30 and December 1

Tuesday	November 29	Practice FLEX Day 1	6:30-9:30 p.m.
Wednesday	November 30	Practice FLEX Day 2	6:30-9:30 p.m.
Thursday	December 1	Practice FLEX Day 3	6:30-10:30 p.m.

Appendix D.: Excerpt from Seniors' Newsletter (Continued)

The Day 1 practice will include 2 1/2 hours of testing, followed by a test-taking post-mortem. The Day 2 session will follow the same format. The Day 3 practice will include 1 1/2 hours of written clinical competence testing with a short post-mortem, followed by small group, "group think" exposure to the last portion of the FLEX. These patient management cases form a portion of the FLEX which you may never have encountered. This "group think" experience will point out valuable strategies for attacking this unusual type of exam. If you have never taken a LATENT IMAGE test, you should plan on attending one of the Day 3 sessions.

If you wish to use the practice FLEX to determine what you need to review, attend one of the early sessions. If you wish to study first and then refresh your test-taking skills just before the FLEX, sign-up for the later sessions. Because we have two editions of the test available, you can attend early and late and take different exams each time. Because of the amount of effort consumed in running these sessions and scoring these practice exams, NO EXTRA sessions will be held.

In 1980-81 more than half of the seniors attended Practice FLEX sessions. These are their comments, based upon taking the December 1980 FLEX.

I. What value did you get from the Practice FLEX?
   1. Test-taking tips for the special patient management portion of Day 3
   2. Test-taking tips for National Board format questions
   3. The opportunity to analyze content weaknesses, to focus review time
   4. The opportunity to think through patient management cases with fellow students.

II. Where was your effort best spent?
   1. Dermatology review
   2. Start months in advance; study a little each day
   3. Review Radiology or take rotation
   4. Take practice FLEX
   5. Use the Clinical Simulations book. It's full of latent image patient management cases (20 of them).
   6. Wynn's OB/Gyn text
   7. Washington Manual
   8. Go through the Pre-Test review books to determine your weak spots
   9. Review Pharmacology - Top 20 drugs
   10. Read October issues of "Resident and Staff Physician," and other issues (all of which have quizzes)
   11. Review antibiotics and mechanics of action just before the FLEX for easy points.

III. Avoid these. They are a waste of time.
   1. Time on basic science review (especially Biochem)
   2. Rypins' Medical Licensure Examinations.

The seniors taking the 1981 and 1982 FLEX had nearly the same comments. One difference was noted; those who reviewed steadily for 3-4 months recommended Rypin's book if you are going to spend about 10 hours per week in review for the exam.